THE BITING MIDGES OF THE BERMUDA ISLANDS, WITH DESCRIPTIONS OF FIVE NEW SPECIES[1]

(DIPTERA, HELEIDAE)

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During June and July, 1955, the junior author conducted light-trap and recovery-cage studies of the Heleidae in each of the several parishes of Bermuda, and made observations on their breeding habits, which he will report on separately. Two pairs of recovery cages were placed for weekly periods in each of 15 areas, and a mosquito light trap was operated for a week in each of 7 of the areas and for 4 days at the Biological Station. In this study 13 species of Heleidae, representing 4 genera, were taken, of which 5 species are new to science.

In the taxonomic descriptions the following terms should be defined: "Antennal ratio" (AR) is the value obtained by dividing the combined lengths of the five elongated distal segments by the combined lengths of the preceding eight, or XI-XV over III-X (in *Pterobosca* the ratio is X-XV over III-IX). "Tarsal ratio (TR) is the value obtained by dividing the length of the hind basitarsus by the length of the second hind tarsomere. Wing length is measured exactly from the basal arculus to the wing tip. The Tillyard modification of the Comstock-Needham system of wing venation is used whereby the branches of the anterior fork are called M_1 and M_2 and the branches of the posterior fork M_{3+4} and Cu_1. The types of the new species here described and most of the material studied are deposited in the U. S. National Museum in Washington, D. C. Paratypes and other specimens when available will be furnished the Museum of Comparative Zoology in Cambridge, Mass., the British Museum (Natural History) in London, and the Bermuda Biological Station, St. George's, Bermuda.

Johnson (1913) mentioned only two species of the family Heleidae (= Ceratopogonidae) from the Bermuda Islands. One, which he described as new under the name *Ceratopogon fur,* was actually *Pterobosca fusicornis* (Coquillett); the second species he referred to only as *Ceratopogon* sp., without notes that would give us a clue to its identity. Ogilvie (1928) does not mention this family as occurring in Bermuda, nor does Waterston (1940).

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KEY TO THE BERMUDA SPECIES OF HELEIDAE

(Based primarily on females)

1. Fore femur with strong ventral spines; tarsal claws large; macrotrichia of wing absent; wing with only one radial cell, the costa extending to 0.72 of distance to wing tip ..... 14. *Bezzia atlantica*, n. sp.
   Fore femur without ventral spines; tarsal claws small; macrotrichia present on wing, usually abundant; wing with two radial cells present; costa extending to less than 0.6 of distance to wing tip 2
2. Empodium well developed; wing with abundant, long appressed macrotrichia; first radial cell narrow, second radial cell not sharply angled at apex 3
   Empodium absent; wing with sparse, suberect macrotrichia 6
3. Terminal six segments of antenna elongated; empodium greatly developed, pad-like TR 3.0 ..... 1. *Pterobosca fusicornis* (Coquillett)
   Terminal five segments of antenna elongated; empodium normal, small; TR 0.5-1.3 4
4. TR 0.5; mesonotum with pale mesal longitudinal band; pleuron with transverse dark band; legs with apices of femora and bases of tibiae dark; wing without pale spots; halter brown ..... 3. *Forcipomyia raleighi* Macfie
   TR 1.0-1.3; mesonotum unicolorous brown; pleuron not banded; legs banded or unbanded; wing with or without pale spots; halter pale or brown 5
5. TR 1.0; legs with broad pale and dark bands; wing with pattern of pale spots; halter knob brownish ..... 4. *Forcipomyia varipennis*, n. sp.
   TR 1.3; legs unbanded; wing uniformly brownish gray; halter pale ..... 2. *Forcipomyia ingrami* Carter
6. First radial cell nearly or completely obliterated, second obliterated or square-ended; humeral pits not developed; eyes pubescent; wing hyaline without color pattern 7
   First and second radial cells well developed, subequal; humeral pits well developed; eyes bare; wing usually with pattern of pale spots 12
7. Abdominal terga with posterior borders narrowly white; large species (wing 1-1.4 mm. long) 8
   Abdominal terga uniformly blackish; small species (wing 0.65-0.9 mm. long) 10
8. Abdominal pleura dappled with many small black streaks; large species (wing 1.4 mm. long); mesonotum with median tuft of scale-like bristles ..... 5. *Dasyhelea cincta* (Coquillett)
   Abdominal pleura uniformly pale or with several large dark areas; medium sized species (wing 1-1.2 mm. long); mesonotum without median tuft of scale-like bristles 9
9. Mesonotum grayish green pollinose; abdominal pleura III-VI extensively black ..... 6. *Dasyhelea grisea* (Coquillett)
   Mesonotum yellowish brown with three obscure darker brown vittae; abdomen without dark areas on pleura III-VI ..... 7. *Dasyhelea luteogrisea*, n. sp.

10. Thorax uniformly dull, jet-black; male dististyle bifid ..... 8. *Dasyhelea scissurae* Macfie

Thorax shining brown to black with yellow scutellum, humeri and pre scutellar and supra-alar spots; male dististyle simple 11

11. Antennal segments longer, segment XI 1.39 times as long as X; second radial cell twice as long as broad; spermatheca 0.04 mm. in diameter with sclerotized base of duct one-third as long as diameter of spermatheca; male genitalia as in figure 1 ..... 9. *Dasyhelea atlantis*, n. sp.

Antennal segments shorter, segment XI 1.25 times as long as X; second radial cell not twice as long as broad; spermatheca 0.06 mm. in diameter with base of duct sclerotized only a short distance; male genitalia as in figure 2 ..... 10. *Dasyhelea bermudae*, n. sp.

12. Color subshining pale yellow; wing without pattern; two spermathecae present ..... 11. *Culicoides floridensis* Beck

Color pruinose grayish brown; wing with pattern of large pale areas; only one spermatheca present 13

13. Wing markings consisting of sharply defined pale areas, second radial cell blackish to tip; mesonotum with prominent pattern ..... 12. *Culicoides crepuscularis* Malloch

Wing markings not sharply defined; second radial cell yellowish at the extreme apex; mesonotum without pattern ..... 13. *Culicoides bermudensis* Williams

1. **Pterobosca fusicornis** (Coquillett)

Ceratopogon fusicornis Coquillett, 1905, Jour. New York Ent. Soc. 13: 63 (female; Biscayne Bay, Florida).

Pterobosca fusicornis Johannsen, 1951, Florida Ent. 34: 117 (records; syn.: *macfiei* Costa Lima and *floridana* Johannsen).

Ceratopogon fur Johnson, 1913, Ann. Ent. Soc. Amer. 6: 444 (female; Bermuda; fig. wing; attached to a small agrionid dragonfly). NEW SYNONYMY.

The two cotypes of *Ceratopogon fur* in the Museum of Comparative Zoology at Harvard University were examined through the courtesy of Dr. P. J. Darlington. One female is attached to the thorax of the agrionid host at the membranous portion at the base of the wings, with the proboscis of the midge parasite piercing the integument of the host. The other cotype female which was glued to a card point on a separate pin was dissected and mounted on a slide by the senior author. Examination of the following characters shows the species to be the same as *Pterobosca fusicornis* (Coquillett), the type of which was used for comparison. Eyes bare; third palpal segment with a shallow, definite pit; tarsal ratio 3.0; tarsal claws each deeply cleft and the two parts each broadly expanded, bladelike; empodium large and broad, modified for clinging; wing 1.13 mm. long, with moderately dense, long, suberect hairs arranged in lines, with narrow bare lines along the veins; halter brown; legs brown; thorax shining brown, with brown hairs, scutellum slightly paler. This species, which was not

taken in the present study, was the only named species of the family previously known from Bermuda.

2. **Forcipomyia ingrami** Carter

Forcipomyia ingrami Carter, 1919, Ann. Trop. Med. Parasit. 12: 290 (male, female; Gold Coast; fig. antenna, wing, tarsus, palpus, genitalia, larva, pupa); Edwards, 1928, Ins. of Samoa, pt. VI, fasc. 2, p. 51 (Samoa); Macfie, 1933, B. P. Bishop Mus. Bull. 114: 94 (Marquesas Ids.); Macfie, 1934, Stylops 3: 133 (Hawaii); Macfie, 1934, Ann. Trop. Med. Parasit. 28: 179 (Malaya).

Specimens examined: 16 males, 314 females, in light traps from Biological Station, Wilkinson Pond, Pampas Farm (South Shore Marsh), Spittal Pond, Paget Marsh, Warwick Marsh, Southampton Marsh, and Evans Pond, and in recovery cages from Pampas Farm, Devonshire Marsh, Paget Marsh, Pembroke Marsh, Warwick Marsh, and Southampton Marsh.

Forcipomyia ingrami is a pale brown, unmarked species with female TR about 1.3, the male TR from 0.8 to 1.1. The male genitalia offer the best characters for the separation of *ingrami* from the related species such as *calcarata* (Coquillett) from Mexico and *quasiingrami* from Brazil; in *ingrami* the aedeagus is in the form of a truncated cone and the sclerotized band of the parameres is broadly U-shaped rather than narrowly V-shaped anteriorly.

Macfie's records of *ingrami* from Trinidad were later referred by him to *quasiingrami*, and the present record constitutes the first authentic record of *ingrami* from the Western Hemisphere.

3. **Forcipomyia raleighi** Macfie

Forcipomyia raleighi Macfie, 1938, Proc. Roy. Ent. Soc. London (B) 7: 160 (male, female; Trinidad; fig. male genitalia).

Specimens examined: 77 males, 36 females, in light traps from Biological Station, Wilkinson Pond, Spittal Pond, Paget Marsh, Southampton Marsh and Evans Pond.

Forcipomyia raleighi is easily recognized by its short basitarsus (TR about 0.5), plain wings, mesally pale mesonotum, dark halteres and dark-banded pleura and banded abdomen. It is widely distributed in the Caribbean area.

4. **Forcipomyia varipennis**, new species

Female.—Length of wing 0.67 mm.

Head brown, eyes bare. Antenna with flagellar segments in proportion of 13:12:12:12:12:12:12:12:15:18:18:18:23, AR 0.95, proximal flagellar segments short, tapering, segments XI-XIV vase-shaped with short distal necks, last segment with terminal papilla which has a spherical tip. Palpal segments in proportion of 10:10:20:10:10, third segment greatly swollen to apex, three-fourths as broad as long, with a large, deep, sensory cavity opening by a small pore. Mouthparts rudimentary, mandibles not developed.

Thorax dark brown, mesonotum and scutellum with numerous long, mixed

brown and golden, upright hairs and appressed slender, yellowish scales. Coxae yellowish; fore and hind tibiae with narrow sub-basal and broader subapical brown bands, the latter subequal in width to the yellowish band of each side; mid tibia brown except at extreme base and apex; tarsi brown with narrow segmental yellow bands. Legs with numerous long, upright, stiff hairs and appressed, narrow, striated scales; six spines in hind tibial comb; hind tibial spur almost half as long as basitarsus, scaly at base; TR 1.0; claws slender and curved, simple.

Wing with abundant long, striated, blackish scales; adorned with small yellowish anterior spot past end of costa and irregular, diffuse, paler areas on distal and posterior portions. Halter knob brownish. Abdomen dark brown with numerous dark brown hairs and slender scales. Spermathecae two, subequal, elongate oval, each measuring 0.035 by 0.055 mm.

Holotype.—Female, Warwick Pond, Bermuda, 4 July 1955, R. W. Williams, recovery cage (type No. 62916, U.S.N.M.). *Paratypes.*—8 females, Bermuda, same data as type; 1 female, Warwick Marsh, recovery cage, 4 July 1955. PUERTO RICO—1 female, El Yunque, 20-23 March, 1954, J. Maldonado and S. Medina. UNITED STATES—1 female, Brownsville, Texas, 1 October 1951, A. B. Gurney, palm grove. GUATEMALA—2 females, Actenango, 22 June 1951, Gibson and Ascoli, at light; 1 female, Yepocapa, 26 July 1951, Gibson and Ascoli, at light.

Forcipomyia cinctipes (Coquillett) from United States (type locality, Florida) is very similar, but has pale halteres, dark coxae, femora dark nearly to bases, the second dark band on hind tibia is twice as broad as the pale bands on each side, the third palpal segment is not greatly swollen and has a small sensory pit and the size averages larger (wing up to 1.4 mm. long). *Forcipomyia ornatipennis* Macfie from Brazil is also related, but also is a larger species (wing 1.3-1.4 mm. long) with three large pale spots on the anterior margin of the female wing, halteres pale, and the legs have more extensive yellow bands on the femora and mid tibia. Macfie's reference (1953, Beitr. zur Ent. 3: 96) to a damaged male specimen of *ornatipennis* from Costa Rica probably refers to *varipennis*.

5. **Dasyhelea cincta** (Coquillett)

Ceratopogon cinctus Coquillett, 1901, Proc. U. S. Nat. Mus. 23: 605 (female; Lake Worth, Florida).

Dasyhelea cincta, Johannsen, 1943, Ann. Ent. Soc. Amer. 36: 778; Wirth, 1952, Univ. Calif. Pub. Ent. 9: 150 (male, female; fig. wing, antenna, palpus, spermathecae, male genitalia; many U. S. localities).

Specimens examined: 7 males, 18 females, from recovery cages at Paget Marsh, Warwick Marsh, and Southampton Marsh.

This is a relatively large species (wing about 1.4 mm. long) with pruinose bluish-black mesonotum spotted with yellowish, especially on the borders, and bearing a tuft of black scale-like bristles in the middle of the mesonotum; wings with bare lines, abdomen with posterior borders of terga white and abdominal pleura with many small black streaks.

6. Dasyhelea grisea (Coquillett)

Ceratopogon griseus Coquillett, 1901, Proc. U. S. Nat. Mus. 23: 602 (female; Washington, D. C., Lake Worth, Florida).

Dasyhelea grisea Thomsen, 1935, Jour. New York Ent. Soc. 43: 283; Wirth, 1952, Univ. Calif. Pub. Ent. 9: 155 (male, female; many U. S. localities; fig. antenna, palpus, male genitalia).

Specimens examined: 19 males, 43 females, from recovery cage at Warwick Marsh.

This moderate sized (wing 1-1.2 mm. long) species can be recognized by its uniformly grayish-green pollinose mesonotum with three narrow darker setigerous vittae; wing with sparse hairs and bare lines; legs pale with blackish knees; abdomen black above, the apices of segments narrowly white-margined; pleura of abdominal segments III-VI extensively black; spermatheca one, oval with a short sclerotized neck; male genitalia with blunt dististyle, a distinct sclerotized hook on mesal margin of basistyle, ninth sternum not produced caudad, and apicolateral processes of ninth tergum well developed.

7. Dasyhelea luteogrisea, new species

Female.— Length of wing 1.0 mm.

Structurally nearly identical with *grisea* (Coquillett). Mesonotum yellowish brown with three broad, obscure, darker, dull, grayish-brown vittae; halter knob yellowish; abdominal pleura without integumental dark patches on segments III-VI, but with denser, longer, conspicuous patches of brownish bristly hairs; all hairs of body slightly longer and more conspicuous than in *grisea*.

Male.—Mesonotum uniformly dark brown with heavy bluish-gray pollinosity; scutellum dull yellowish brown. Genitalia with spine of apicolateral processes of ninth tergum short and stout. Otherwise as in *grisea*.

Types.—Holotype female, allotype male, Bermuda, from recovery cage at Spittal Pond, 17-23 June 1955, R. W. Williams (type No. 62917, U.S.N.M., mounted on slides). Paratypes: 250 males, females, Bermuda, from recovery cages at Spittal Pond, Trott's Pond, Paget Marsh, Warwick Pond, Warwick Marsh, Evans Pond, Southampton Marsh and Mid-Ocean Country Club Pond, and in the light trap at Spittal Pond. Also the following paratypes: United States—22 males, 7 females, Lake Worth, Florida, 9 August 1951, W. W. Wirth, light trap; 7 males, 13 females, North Miami Beach, Florida, 18 April 1951, J. E. Porter, light trap; 3 females, Lake Charles, Louisiana, 9 June 1917, J. M. Aldrich; 2 females, Galveston, Texas, 16 April 1905, W. D. Pierce, on *Tamarix gallica*. Bahamas—1 female, South Bimini Island, June 1951, Cazier and Vaurie.

This species is evidently a salt marsh relative of *Dasyhelea grisea* (Coquillett), with which it occasionally occurs, but without showing evidence of interbreeding.

8. **Dasyhelea scissurae** Macfie

Dasyhelea scissurae Macfie, 1937, Ann. Mag. Nat. Hist. (10) 20: 15 (male; Trinidad; fig. genitalia); Macfie, 1953, Beitr. zur Ent. 3: 103 (male, female; Costa Rica).

Specimens examined: 2 males, 1 female, Paget Marsh, light trap, 28 June and 1 male, Evans Pond, in light trap, 12-18 July 1955.

The uniformly dull, jet-black color with only the halteres white, small size (wing 0.9 mm. long) and the bifid male dististyles will readily identify this species.

9. **Dasyhelea atlantis**, new species

(Figure 1)

Male, female.—Length of wing 0.75-0.8 mm.

Color in specimens preserved in alcohol shining dark brown; male mesonotum uniformly blackish, female mesonotum paler brown with humeri, supra-alar spots and a pair of oval spots in prescutellar depression, yellowish. Scutellum yellowish, with six bristles; postscutellum and pleuron dark brown. Antenna brown, palpus yellowish; legs yellowish, femora and tibiae more or less infuscated; halter knob whitish, stem dark; wing grayish hyaline, the radial cells slightly darkened; abdominal terga uniformly blackish. Eye pubescent. Antenna with flagellar segments in proportion of 15:10:11:11:12:12:13:13:18:18:18:18:25; tenth segment 1.6 times as long as broad; last segment without terminal stylet. Palpal segments in proportion of 15:25:12:12. TR 2.4; six or seven spines in hind tibial comb. Wing with second radial cell twice as long as broad, macrotrichia numerous, arranged in lines on disc but forming patches on distal and posterior wing margins. Spermatheca one, subspherical, diameter about 0.04 mm., with a very slender sclerotized duct one-third as long as diameter of spermatheca. Male genitalia as in figure 1.

Holotype.—Male, Bermuda, from recovery cage at Trott's Pond, 10 June 1955, R. W. Williams (type No. 62919, U.S.N.M., on slide). *Allotype.*—Female, from recovery cage at Spittal Pond, 17-23 June 1955. *Paratypes.*—About 700 males and females, from recovery cages, during June and July from Lovers Lake, Wilkinson Pond, Trott's Pond, Spittal Pond, Warwick Pond, Seymour Pond, Evans Pond, Pilchard Bay and Mid-Ocean Country Club Ponds, and from the light trap at Spittal Pond, 17-23 June 1955.

10. **Dasyhelea bermudae**, new species

(Figure 2)

Male, female.—Length of wing 0.65-0.70 mm.

Very similar in color markings to *atlantis*, the shining blackish mesonotum with yellowish humeri and prescutellar spots outstanding. Structurally as in *atlantis*, but differing as follows: Antennal segments slightly shorter, flagellar segments in proportion 15:12:12:12:12:12:12:12:15:15:15:15:20. Wing slightly hairier, second radial cell not quite as long as broad. Spermatheca larger, diameter about 0.06 mm., the base of the duct sclerotized only a short distance. Male genitalia quite different, as in figure 2.

Holotype.—Male, Bermuda, from recovery cage at Warwick Pond, 4 July 1955, R. W. Williams (type No. 62918, U.S.N.M., on slide). *Allotype.*—Female, from recovery cage at Pampas Farm, 21-27 June 1955. *Paratypes.*—50 males, 75 females, from recovery cages during June and July at Pampas Farm, Devonshire Marsh, Paget Marsh, Warwick Pond, Warwick Marsh, Seymour Pond, and Southampton Marsh.

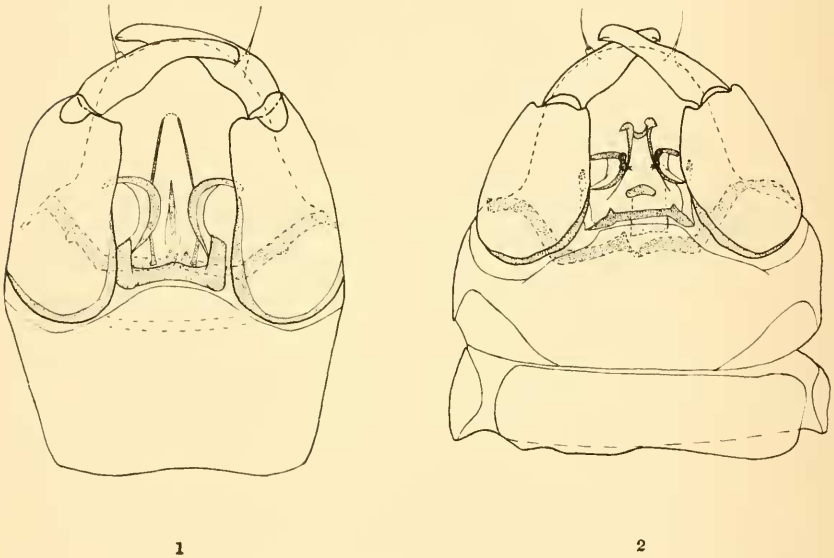

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Fig. 1, male genitalia of *Dasyhelea atlantis;* fig. 2, male genitalia of *Dasyhelea bermudae.* The stippling represents areas of greater sclerotization.

11. **Culicoides floridensis** Beck

Culicoides floridensis Beck, 1951, Florida Ent. 34: 135 (male, female; Florida; fig. male genitalia).

Specimens examined: Only 3 males and 3 females were taken, these in the light trap at Wilkinson Pond.

Culicoides floridensis is somewhat similar to *melleus* of the Atlantic and Gulf Coasts of the United States, in that it is a pale yellowish species with unspotted wings, but the wings of *floridensis* are relatively barer and the female has the spermathecae less heavily sclerotized. The male genitalia of *floridensis* have normal dististyles, conspicuously spinose parameres, and a V-shaped aedeagus, whereas those of *melleus* have the dististyles conspicuously bent, the parameres simple and the aedeagus massive, with high arch and truncate tip.

12. **Culicoides crepuscularis** Malloch

Culicoides crepuscularis Malloch, 1915, Bull. Illinois St. Lab. Nat. Hist. 10: 303 (male, female; Illinois, Michigan, Arizona; fig. wing, mesonotum, male antenna, genitalia); Foote and Pratt, 1954, Pub. Hlth. Monogr. 18: 19 (redescribed, records, fig. wing, mesonotum, palpus, male genitalia).

Specimens examined: 176 females and 74 males from a light trap at Biological Station, Wilkinson Pond, Spittal Pond, Pampas Farm, Paget Marsh, Warwick Marsh, Southampton Marsh, and Evans Pond, and 577 males and 658 females from recovery cages at Pampas Farm, Devonshire March, Paget Marsh, Pembroke Marsh, Warwick Marsh, Seymour Pond, Southampton Marsh, Pilchard Bay, and the larger of the two Mid-Ocean Golf Course Ponds.

This species is a close relative of *canithorax* Hoffman and *alaskensis* Wirth from North America, as well as *bermudensis* with which it was associated in Bermuda. *Crepuscularis* can be distinguished from these species by its conspicuous wing pattern of definite rounded spots and by the prominent mesonotal pattern consisting of a median longitudinal diamond-shaped anterior band and a pair of crescent-shaped lateral bands which are dark brown on a pruinose grayish background.

13. **Culicoides bermudensis** Williams

Culicoides bermudensis Williams, 1956, Jour. Parasit. 42(3): 297-300. (female; Bermuda; fig. wing, palpus).

Specimens examined: 224 females in light trap from Pampas Farm, Paget Marsh and Southampton Marsh, and 111 females in recovery cages from Trott's Pond, Devonshire Marsh, Paget Marsh, Pampas Farm, Warwick Pond, and Southampton Marsh.

Culicoides bermudensis is a small, brownish, poorly marked species. The female is closely related to *canithorax* of North America, but differs from it in possessing 8 or less mandibular teeth instead of 15, the AR is less than 1.2, the distance between the eyes is about 2.5 times as great, the palpus and wing are less than two-thirds as long, macrotrichia are sparse, the first spine of the hind tibial comb is the longest, the long axis of the distal pale spot in cell R_5 lies at a 45° angle to vein M_1 and the single spermatheca is more than 1.5 times as large as in *canithorax*. No males were collected.

14. **Bezzia atlantica**, new species

Male, female.—Length of wing 1.2 mm.

Head brown; antenna and palpus pale brown, basal rings of antennal segments at the verticils whitish; flagellar segments in proportion of 20:18:18:19:20:22:23:24:35:35:30:40:44. Palpal segments in proportion of 8:12:20:12:18. Mandible with ten teeth. Thorax in preserved specimens dark brown, with short dark pubescence, extent of pruinose pattern undetermined; four or five long black bristles above wing base; scutellum yellowish, with four strong black bristles. Legs dark brown; broad yellow bands on middle of hind femur, at base and before apex of fore tibia, on distal half of mid tibia but leaving extreme apex dark, and

on middle third of hind tibia; tarsi yellowish. Legs moderately stout; fore femur with three long, rather slender, black spines on flexor side, fore and mid femora with one apical extensor spine, hind femur with extensor series of three or four bristles; claws black, equal, each with a strong, blunt, basal tooth; TR about 2.0. Wing yellowish hyaline, costa extending to 0.72 of wing length; medial fork sessile. Halter brown. Abdomen dull yellowish brown; female with one pair of gland rods as long as 3.5 segments. Female spermathecae two, pyriform, subequal. Male genitalia as figured by Wirth (1952, fig. 27 f) for *setulosa*.

Holotype.—Male, Bermuda, Devonshire Marsh, from recovery cage, 21-27 June 1955, R. W. Williams (type No. 62920, U.S.N.M. on slide). *Allotype*.—Female, Bermuda, Pampas Farms, from recovery cage, 21-27 June 1955. *Paratypes*.—4 males, 4 females, same data as holotype.

Bezzia setulosa (Loew), a common Nearctic species, is closely related, but differs in having the legs more extensively yellowish, the femora with very broad pale bands at midlength and the fore femur with an additional pale preapical ring, the pale tibial bands are also slightly broader, the female gland rods extend through 4.5 segments and the spermathecae are not distinctly pyriform.

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